What is claimed is:

1. A liquid distillation system comprising:
   a) an input for receiving untreated liquid;
   b) a vaporizer coupled to the input for transforming the liquid to vapor;
   c) a head chamber for collecting vapor from the vaporizer;
   d) a vapor pump for compressing the vapor, the vapor pump comprising:
      i. an internal drive shaft; and
      ii. an eccentric rotor with a rotatable housing; and
   e) a condenser in communication with the vapor pump for transforming compressed vapor into a distilled liquid product.

2. The liquid distillation system as in claim 1 wherein the rotor further comprises a multiplicity of vanes separated by chambers, each chamber having an intake and an exit.

3. A liquid distillation system according to claim 1 wherein the input is coupled to at least one heat source.

4. A liquid distillation system according to claim 1 further comprising a sump wherein liquid from the vaporizer may be preheated at start-up.

5. A liquid distillation system according to claim 4 wherein the vaporizer has a plurality of parallel tubes, each tube having a first open end in communication with the sump and a second open end in communication with the head chamber.

6. A liquid distillation system according to claim 5 further comprising a regulator for maintaining a liquid level sufficient to permit both purification of liquid from the core vaporizer tubes.

7. A liquid distillation system according to claim 1, the system further comprising a regulator for maintaining and controlling pressure in the condenser.

8. A liquid distillation system according to claim 1 further comprising an output for collection of condensed liquid product and further in connection with the input for recycling the blowdown stream.

9. A liquid distillation system according to claim 1 further comprising a pre-treatment assembly coupled to the intake.

10. A liquid distillation system according to claim 9 wherein the liquid pre-treatment assembly performs at least one of a plurality of treatments including filtering, degassing, chemical modification, UV light exposure, treatment with polyphosphates, polyacetates, polyaspartates, organic acids, acidification including addition of CO_2 from an external engine, exposure to an oscillating electric field, and any other suitable pre-treatment process.

11. A liquid distillation system according to claim 1, the system further comprising a heating unit for heating intake liquid upon startup.

12. A liquid distillation system according to claim 11, the system further comprising a switch including a thermostatic switch, pressure-sensing switch or related thermal or pressure transducer for signaling completion of the heating phase and turning off the heating unit.

13. A liquid distillation system according to claim 1 further comprising a heat exchanger for receiving liquid from the input such that heat from at least one source is exchanged with the input liquid.

14. A liquid distillation system according to claim 13 wherein the at least one heat source includes the product stream, the blowdown stream, system waste heat, vapor pump waste heat, motor waste heat, engine exhaust heat from a power source, and an external heat source.

15. A liquid distillation system according to claim 13 wherein the heat exchanger is a multi-line exchanger for exchanging heat from a number of sources with the input liquid.

16. A liquid distillation system according to claim 1 wherein the drive includes an electric motor.

17. A liquid distillation system according to claim 1 wherein the vaporizer includes an electrical heater.

18. A liquid distillation system according to claim 1, the system further comprising a multi-unit filter having at least two units in the input for filtering the liquid before the liquid is received by the vaporizer.

19. A liquid distillation system according to claim 18 wherein the filter is a flip-filter.

21. A liquid distillation system according to claim 18 further comprising a diverter whereby the filter is back-washed by a blowdown stream diverted from the head chamber.

22. A liquid distillation system according to claim 21 further comprising a regulator coupled to the diverter for providing the minimum flow rate of blowdown stream necessary to back-wash the filter.

20. A liquid distillation system according to claim 19, the system further comprising a mechanism for periodically rotating the flip-filter at appropriate intervals for back-washing filter units to prevent fouling.

23. A liquid distillation system according to claim 20, the system further comprising a switch for changing the direction and source of liquid flowing through the filter for back-washing to prevent fouling.

24. A liquid distillation system according to claim 1 further comprising a power source coupled to the system wherein the power source is a clean-burning generator.

25. A liquid distillation system comprising:

a) an input for receiving untreated liquid;

b) a vaporizer coupled to the input for transforming the liquid to vapor;

c) a head chamber for collecting vapor from the vaporizer;

d) a vapor pump for compressing the vapor, the vapor pump comprising:

1. an internal drive shaft; and

2. an eccentric rotor; and

e) a condenser for transforming compressed vapor from the vapor pump into a distilled liquid product; and

f) a multi-unit filter having at least two filter units in the input for filtering liquid before it is received by the vaporizer.

26. A liquid distillation system according to claim 25 further comprising a diverter whereby at least one filter unit is back-washed by a blowdown stream diverted from the head chamber.

27. A liquid distillation system according to claim 26 further comprising a regulator coupled to the diverter for providing the minimum flow rate of blowdown stream from the head chamber necessary to back-wash the at least one filter unit.

28. A liquid distillation system according to claim 26 wherein the multi-unit filter is a flip-filter.

29. A liquid distillation system according to claim 28 further comprising a mechanism for periodically rotating the flip-filter at appropriate intervals to prevent fouling.

30. A liquid distillation system according to claim 25 further comprising a heat exchanger for receiving liquid from the intake such that heat from at least one of a plurality of sources is added to the input liquid.

31. A liquid distillation system according to claim 30 wherein the at least one of a plurality of heat sources includes the product stream, the blowdown stream, system waste heat, vapor pump waste heat, motor waste heat, exhaust heat from a power source, and an external heat source.

32. A liquid distillation system according to claim 30 wherein the heat exchanger is a multi-line heat exchanger for exchanging heat from a number of heat sources with the input liquid.

33. A flip-filter module comprising:

a) a first flip-filter unit for filtering an intake stream of liquid;

b) a second flip-filter unit, capable of being cleared by a backwash stream, coupled to the first flip-filter by a pivot joint disposed between first and second flip-filter units; and

c) a flip-switch for rotating the first and second flip-filters to allow the backwash stream to clear the first flip-filter as the second flip-filter is positioned to filter the intake stream.

34. A multi-line heat exchanger, the multi-line heat exchanger comprising:

a) a first input for receiving a stream of a first fluid;

b) a second input for receiving a stream of a second fluid;

c) a third input for receiving a stream of a third fluid;

d) an interface for transferring heat from the first and second fluids to the third fluid in such a manner that all of the fluids are isolated from one another;

e) a first heat source stream from a first heat source coupled with the intake stream in a first sub-heat exchanger;

f) a second heat source stream from a second heat source coupled with the intake stream from the first sub-heat exchanger in a second sub-heat exchanger; and

g) at least a third heat source stream, originating from the first heat source or from a third heat source, coupled with the intake stream from the second heat sub-heat exchanger in at least a third sub-heat exchanger.

35. A liquid distillation system comprising:

a) an input for receiving untreated liquid;

b) a vaporizer coupled to the input for transforming the liquid to vapor;

c) a vapor pump for compressing the vapor, the vapor pump comprising:

i. an internal drive shaft;

ii. an eccentric rotor with a rotatable housing; and

iii. a siphon pump to pump liquid into the vapor pump; and

d) a condenser in communication with the vapor pump for transforming compressed vapor into a distilled liquid product.

36. A method for distilling a liquid comprising:

a. vaporizing untreated liquid to form a vapor in such a way as to fill a head chamber;

b. compressing the vapor by rotating the vapor within the head chamber using an internal drive shaft and eccentric rotor with a rotatable housing; and

c. condensing the compressed vapor into a distilled liquid product.

37. A method of distilling a liquid according to claim 36, further comprising pre-treating the untreated liquid using at least one pre-treatment method including UV light exposure, treatment with polyphosphates, polyacetates, polyaspartates, organic acids, acidification, including addition of CO_2 from an external engine, and exposure to an oscillating electric or magnetic field.

38. A method of distilling a liquid according to claim 36, further comprising regulating the internal pressure of the condenser.

39. A method of distilling a liquid according to claim 38, further comprising maintaining a super-atmospheric pressure.

40. A method of distilling a liquid according to claim 36, further comprising maintaining a liquid level in the head chamber sufficient to permit both purification of liquid from the core vaporizer tubes.

41. A method of distilling a liquid according to claim 36, further comprising disposing a multi-unit filter having at least two filter units in the input for filtering liquid before it is received by the vaporizer.

42. A method of distilling a liquid according to claim 41 further comprising diverting a blowdown stream from the head chamber for back-washing at least one filter unit.

43. A method of distilling a liquid according to claim 42 further comprising regulating the blowdown stream to provide the minimum flow rate necessary to back-wash the at least one filter unit.

44. A method of distilling a liquid according to claim 42 wherein the filter is a flip-filter.

45. A method of distilling a liquid according to claim 44, further comprising rotating the flip-filter at regular intervals to prevent fouling.

46. A method of distilling a liquid according to claim 36, further comprising using an electric motor to drive the pump.

47. A method of distilling a liquid according to claim 46, further comprising operating the system with a power budget of about 500 watts to produce about ten gallons of purified liquid per hour.

48. A method of distilling a liquid according to claim 47, further comprising operating the system on power budget between about 250 and 400 watts to produce between about three to eight gallons of purified liquid per hour.

49. A method of distilling a liquid according to claim 36, further comprising coupling a clean-burning generator to the system.

50. A method of distilling a liquid according to claim 49, further comprising coupling a clean-burning generator to the system wherein the exhaust produced by the generator comprises mainly CO_2, N_2, and water.

51. A method for of distilling a liquid according to claim 49 or 50, further comprising directing the exhaust to the intake liquid for pre-treatment acidification and heating of the intake liquid.

52. A method of distilling a liquid according to claim 36, further comprising using an eccentric rotor having a multiplicity of vanes separated by chambers, each chamber having an intake hole and an exit hole.

53. A method of distilling a liquid according to claim 36, further comprising eliminating entrained liquid droplets from the vapor in the vapor pump

54. A method of distilling a liquid according to claim 36, further comprising using a vaporizer connected to a sump, said vaporizer having a plurality of parallel tubes, each tube having a first end in communication with the sump and a second end in communication with the head chamber.

55. A method of distilling a liquid according to claim 36, further comprising post-treating the distilled liquid product.

56. A method of distilling a liquid according to claim 36, further comprising using a heat exchanger for receiving liquid from the input wherein heat from at least one source is exchanged with the input liquid.

57. A method of distilling a liquid according to claim 56, further comprising exchanging heat with the liquid in the heat exchanger from the at least one source including the product stream, the blowdown stream, system waste heat, vapor pump waste heat, exhaust heat, and an external heat source.

58. A method of distilling a liquid according to claim 56, further comprising using a three-line heat exchanger for exchanging heat from the product stream and the blowdown stream with the input liquid.

59. A method of distilling a liquid according to claim 36, further comprising priming the system before start-up with a minimal amount of liquid.

60. A backpressure regulator comprising:

a hinged arm having a closed position; and

a movable stop shaped to cover a port connected to a pressurized conduit, the stop being held by a retainer attached to the arm, and the stop being positioned adjacent to the port when the arm is in the closed position,

wherein the arm is away from the closed position when the pressure in the conduit exceeds a set point, and the arm is in the closed position when the pressure in the conduit is less than the set point.

61. A backpressure regulator according to claim 60 further comprising a counter mass adjustably attached to the arm.

62. A backpressure regulator according to claim 61, wherein changing the counter mass position with respect to the arm changes the set point.

63. A backpressure regulator according to claim 60, wherein the counter mass is adjustably attached such that the lowest set point is substantially less than or equal to 10 psig.

64. A backpressure regulator according to claim 60, wherein the counter mass is adjustably attached such that the highest set point is substantially greater than or equal to 17 psig.

65. A backpressure regulator according to claim 60, further comprising a specifically designed leak vent at least when the arm is in the closed position.

66. A backpressure regulator according to claim 60, wherein the movable stop is substantially ball-shaped.

67. A backpressure regulator according to claim 60, wherein the regulator is utilized in a vapor compression distillation system.

68. A backpressure regulator according to claim 60 further comprising a vessel having an orifice connected to the pressurized conduit, wherein the port is an opening of the orifice and the arm is hinged to the pressure vessel.

69. A backpressure regulator according to claim 68, wherein the vessel includes a drain orifice.

70. A method for removing contaminants from water, the method comprising:

a. driving an electric generator by means of a thermal cycle engine for generating electrical power capacity, the thermal cycle engine including a burner for combusting a fuel;

b. employing at least a portion of the electrical power capacity of the electric generator for powering a water purification unit;

c. supplying source water to an input of the water purification unit; and

d. conveying heat output of the thermal cycle engine for supplying heat to the water purification unit to reduce the amount of electrical power required to purify the water.

71. A method for removing contaminants from water in accordance with claim 70, wherein the step of conveying exhaust heat output further includes transferring heat from an exhaust gas of the burner to source water supplied to the water purification unit.

72. A method for removing contaminants from water in accordance with claim 70, wherein the step of conveying exhaust heat output further includes heating an enclosure surrounding the water purification unit for reducing thermal losses.

73. A method in accordance with claim 70, wherein the method further includes the steps:

e. vaporizing the untreated water; and

f. condensing the vaporized water into a distilled water product.

74. A method for removing contaminants from water in accordance with claim 73, wherein the step of conveying exhaust heat output further includes transferring heat from an exhaust gas of the burner to source water supplied to the water purification unit.

75. A method for removing contaminants from water in accordance with claim 73, wherein the step of conveying exhaust heat output further includes heating an enclosure surrounding the water purification unit for reducing thermal losses.

76. A method for concentrating contaminants removed from water, the method comprising:

a. driving an electric generator by means of a thermal cycle engine for generating electrical power capacity, the thermal cycle engine including a burner for combusting a fuel;

b. employing at least a portion of the electrical power capacity of the electric generator for powering a water purification unit;

c. supplying source water to an input of the water purification unit;

d. conveying heat output of the thermal cycle engine for supplying heat to the water purification unit;

e. vaporizing the untreated water; and

f. collecting contaminants removed from the water.

77. A system for distilling water for human consumption, the system comprising:

a. a thermal cycle engine including a burner for combusting a fuel for driving an electric generator to generate electrical power capacity;

b. a water purification unit powered by the electric generator;

c. an input for receiving source water for distillation by the water purification unit; and

d. a conduit for conveying heat output of the thermal cycle engine to the water purification unit.

78. The system of claim 74, wherein the conduit is a hose for conveying heated gas from the burner of the thermal cycle engine to the water purification unit.

79. The system of claim 74, further comprising a heat exchanger in a path of the source water from the input to the water purification unit.

80. The system of claim 74, wherein the thermal cycle engine is an external combustion engine.

81. The system of claim 74, wherein the thermal cycle engine is a Stirling cycle engine.

82. A liquid distillation system according to claim 1, wherein the vapor pump includes a liquid ring pump.

83. A liquid distillation system according to claim 82 further comprising a volatile mixer to cool hot gases and release volatiles.

84. A liquid distillation system according to claim 35, wherein the vapor pump includes a liquid ring pump.

85. A liquid distillation system according to claim 1 further comprising a heat exchanger for receiving liquid from the input such that heat from at least one source is exchanged with the input liquid.

86. A liquid distillation system according to claim 85 wherein the at least one heat source includes the product stream, the blowdown stream, system waste heat, vapor pump waste heat, motor waste heat, engine exhaust heat from a power source, and an external heat source.

87. A method of distilling a liquid according to claim 55, wherein post-treating includes at using at least one of UV light exposure and other sterilization methods suitable for maintaining potability.

88. A method of distilling a liquid according to claim 55, wherein post-treating includes adding an additive to the liquid.

89. A method of distilling a liquid according to claim 88, wherein the additive is at least one of a sugar-based additive, an acid, and a mineral.

90. A method of distilling a liquid according to claim 88, wherein the additive is at least one of a nutrient, a vitamin, a stabilized protein, and a fat.

91. A method of distilling a liquid according to claim 88, wherein post treating includes measuring a physical property of the liquid.

92. A method of distilling a liquid according to claim 91, wherein measuring a physical property of the liquid includes measuring at least one of pH, conductivity, hardness, and a concentration of a component in the liquid.

93. A method of distilling a liquid according to claim 36, further comprising:
measuring the TDS in a blowdown liquid from the vaporized untreated liquid; and
adjusting a source feed rate of untreated liquid if the TDS is above a prescribed level.

94. A liquid distillation system according to claim 1, wherein the condenser and the vaporizer are in thermal contact.

95. A liquid distillation system according to claim 94, wherein the condenser includes a surface with a hydrophobic coating, the surface configured to contact compressed vapor and liquid.

96. A liquid distillation system according to claim 4, wherein the vaporizer has a plurality of parallel core layers with rib sections that create channels for directing steam and condensed liquid flow.

97. A liquid distillation system according to claim 96, wherein alternating parallel core layers comprise an evaporator channel and a condenser channel such that evaporation and condensation are separated.

98. A liquid distillation system according to claim 97, further comprising a fluid distribution manifold having flow regulation, mist removal, and pressure regulation in a single unit.

99. A liquid distillation system according to claim 98, wherein core plates and manifolding may be made of, for example, plastic, metal, or ceramic plates, or any other non-corrosive material capable of withstanding high temperature and pressure.

100. A liquid distillation system according to claim 97, further comprising a fluid distribution manifold having flow regulation, mist removal, and pressure regulation in a single unit.

101. A liquid distillation system according to claim 100, wherein core plates and manifolding may be made of, for example, plastic, metal, or ceramic plates, or any other non-corrosive material capable of withstanding high temperature and pressure.

102. A liquid distillation system according to claim 1, further comprising:

a pump for pumping untreated liquid into the vaporizer;

an air vent on an outlet side of the pump; and

a valve;

wherein the pump, air vent, and valve are configured in a loop permitting re-priming of the pump when the evaporator is pressurized.